

Project Overview

Environmental education curriculum materials are, by their very nature, interdisciplinary. The wide spectrum of environmental topics and issues addressed in textbooks and supplementary materials alike are often interrelated. As more and more materials emerge to address environmental issues, teachers are in a quandary over which curriculum materials to choose. To make this review of materials manageable, existing curricula were sorted by logical, related topical areas, such as energy resources, water resources and air resources, to mention a few.

Linking Water and Energy

To determine the feasibility of linking agency efforts, the project began with water and energy as logical prototypes because both the California Energy Extension Service in the Governor's Office of Planning and Research and the California Department of Water Resources had published bibliographies of curriculum materials in the 1980s. This project links those two bibliographies by (1) linking the work of the resource agencies with the Department of Education through the matrix of *Unifying Concepts of Environmental Education* developed by the California Department of Education; (2) establishing a *Conceptual Matrix* for each topical area based on those concepts; and (3) systematically reviewing, rating, and ranking selected environmental curricula.

Collaborative Project for Resource Agencies

The success of that coordinating effort produced two *Compendia* and provided a cohesive foundation upon which subsequent compendia for environmental education were based. Partners were identified from other resource agencies. The third compendia, *Integrated Waste Management*, was published in June, 1993. The fourth compendia, *Human Communities*, was published in May 1994. The final two, *Air Quality* and *Natural Communities* are expected in Fall 1994. Staff development workshops are being offered for all topical areas.

Story Line: Awareness, Understanding, and Action

Both the *Conceptual Matrix for Energy Education* and the *Unifying Concepts of Environmental Education* on pages 34 and 35 are based upon

the Superintendent's *Point of View on Environmental Education* prepared by the California Department of Education in 1990. The content of environmental education is derived from the 1981 version of the *California Environmental Education Guide*, published by the Alameda County Office of Education. The content and processes of environmental education form the "X" and "Y" axes of the matrices that follow.

The nine cells of the conceptual matrix form a storyline which we hope students will be able to tell about energy resources. The story begins with an awareness and appreciation of how energy is used in the natural and built environments. The plot's substance and form are further developed by understanding how energy's physical and chemical properties enable life. The story culminates with student recognition of sustained responsible action through energy conservation, civic responsibilities, and personal choices. Students may tell their stories about energy resources through the visual and performing arts, mathematics, and language arts.

The basic concepts of energy resources correspond to the content of the *History-Social Science Framework for California Public Schools* (1988) and the *Science Framework for California Public Schools* (1990). Each concept may be further expanded by grade-level spans, which are kindergarten through third grade, third through sixth grade, sixth through ninth grade, and ninth through twelfth grade.

Environmental Themes

Woven throughout the basic concepts are several themes, or big ideas, for environmental education. The most prominent themes are: the development of **appreciation and deep respect** for the environment; the **systems and interactions** of living and nonliving things; and the importance of **conservation** as the cornerstone of sustainable communities.

Unifying Concepts Of Environmental Education

Content Process	NATURAL ENVIRONMENT Natural Systems and Interactions	BUILT ENVIRONMENT Human Alterations to Natural Systems	PERSONAL ENVIRONMENT Citizens' Roles, Responsibilities, Choices, and Actions
 fostering awareness of and Appreciation for the environment	<p>Environmentally aware citizens cultivate in themselves and others a deep appreciation for natural systems and personal interactions with the natural environment.</p> <p><i>California Curriculum Framework References: Science: Living Things, Ecosystems, Oceanography</i></p>	<p>Members of sustainable human communities value the natural environment and recognize humankind's ultimate dependence upon renewable and nonrenewable resources.</p> <p><i>History and Social Science : Geographic Literacy; Science: Geology and Natural Resources, Living Things, Ecosystems</i></p>	<p>An individual's quality of life and attitude toward the environment depend upon the distribution and quality of natural resources, which may be regulated by laws and influenced by local interests, cultural values, political climate, and international relations.</p> <p><i>History and Social Science : Sociopolitical Literacy, Cultural Literacy, Constitutional Heritage, National Identity</i></p>
 understanding basic environmental concepts	<p>Individuals understand the relationship between the living and non-living components of natural systems.</p> <p><i>Science: Living Things, Energy, Ecosystems, Matter</i></p>	<p>Human Communities understand how they alter the natural and built environments. As human populations increase, their impacts on the global environment are more pronounced.</p> <p><i>History and Social Science : Historical Literacy, Geographic Literacy; Science: Geology and Natural Resources, Science, Technology and Society</i></p>	<p>Individuals, communities, and societies understand and honor the symbiotic relationship between the natural and built environments such that a sustainable global community is created.</p> <p><i>History and Social Science : Civic Values, Rights and Responsibilities, Sociopolitical Literacy, Participation Skills</i></p>
 taking responsible actions toward the environment	<p>Individuals take appropriate, knowledgeable actions to restore, preserve and protect the integrity of natural systems and interactions.</p> <p><i>History-Social Science : Historical Literacy, Ethical Literacy; Science: Ecosystems, Geology and Natural Resources</i></p>	<p>Members of sustainable human communities learn from past experiences, acknowledge human limitations, anticipate changes, and develop innovative systems to conserve resources and promote the vitality of both the natural and built environments.</p> <p><i>History and Social Science : Ethical Literacy, Critical Thinking Skills, Historical Literacy, Economic Literacy; Science: Geology and Natural Resources, Science, Technology and Society</i></p>	<p>Informed citizens influence the development of a sustainable global community through individual and collective actions, civic and organizational responsiveness, lifestyle choices, cultural sensitivity, career selection, regulatory and statutory processes, and economic practices.</p> <p><i>History and Social Science : Civic Values, Rights and Responsibilities, Economic Literacy, Critical Thinking Skills, Participation Skills; Science: Science, Technology and Society</i></p>

Conceptual Matrix For Energy Education

<div>Content</div> <div>Process</div>	NATURAL ENVIRONMENT Natural Systems and Interactions	BUILT ENVIRONMENT Human Alterations to Natural Systems	PERSONAL ENVIRONMENT Citizen's Roles, Responsibilities, Choices, and Actions
Fostering Awareness of and Respect for the Environment	<p>All life requires energy which is the essential force causing change.</p> <p><i>California Curriculum Framework References: Science: Ecosystems, Energy: Sources and Transformations</i></p>	<p>Human communities develop and depend on energy from renewable and nonrenewable sources, altering the natural environment positively and negatively in the process.</p> <p><i>Science : Energy: Sources and Transformations, Energy: Heat, Energy: Electricity and Magnetism: History and Social Science: Historical Literacy, Geographic Literacy, Economic Literacy</i></p>	<p>The quality of life for individuals and societies depends upon the distribution of energy, a valuable, regulated commodity.</p> <p><i>History and Social Science : Cultural Literacy, Geographic Literacy, Sociopolitical Literacy</i></p>
Understanding Basic Environmental Concepts	<p>The sun is the primary energy source for almost all ecosystems and cycles; energy is transformed and often converted to unused heat, but never lost.</p> <p><i>Science: Energy: Sources and Transformations, Ecosystems</i></p>	<p>Energy development, distribution, and use have long-term and short-term economic, environmental, social, and political benefits and drawbacks.</p> <p><i>History and Social Science : Economical Literacy, Sociopolitical Literacy: Science: Energy: Heat, Energy: Electricity and Magnetism, Ecosystems</i></p>	<p>People, through their expectations for a certain quality of life, lifestyle choices, and personal use of energy, create demands for certain types of energy.</p> <p><i>History and Social Science : Civic Values, Rights and Responsibilities, Sociopolitical Literacy, Participation Skills</i></p>
Taking Responsible Actions Toward the Environment	<p>The complexity or simplicity of food webs affects the flow of energy through ecosystems; thus, the preservation and thoughtful management of the natural environment as a whole is crucial for natural cycles to support life.</p> <p><i>History and Social Science : Participation Skills, Critical Thinking Skills; Science: Ecosystems, Geology and Natural Resources</i></p>	<p>Individual members of sustainable human communities use and conserve energy and develop renewable energy sources in anticipation of the needs of future generations.</p> <p><i>History and Social Science : Geographical Literacy, Critical Thinking Skills, Economic Literacy; Science: Geology and Natural Resources, Science, Technology and Society</i></p>	<p>People, through careers and civic responsibility plan for the development, efficient use, regulation, conservation, and protection of energy resources based on an analysis of the benefits costs, tradeoffs and long-term impacts on the natural and built environments.</p> <p><i>History and Social Science : Civic Values, Rights and Responsibilities, Participation Skills, Critical Thinking Skills; Science: Science, Technology and Society, Geology and Natural Resources</i></p>

Scale for evaluating materials:

1. Do the materials encourage hands-on experience?
2. Do the materials offer the students the opportunity to practice scientific thought processes (e.g., hypothesis making, problem- solving, collecting and organizing data, analysing, drawing conclusions?)
3. Is the content treated accurately?
4. Are concepts organized thematically?
5. Do the instructional materials offer opportunities for different learning modes?
6. Are concepts open to inquiry, presented non-dogmatically?
7. Are assessment devices appropriate?
8. Are the concepts being taught related directly to the students' problem-solving experiences?
9. Is the learning environment expanded, using the outdoors, field trips, outside speakers, etc.?

10. Is the depth of treatment of the material adequate?
11. Is the material appropriate for the age level designated?
12. Are materials relevant to both rural and urban settings?
13. Are individual values included, as they pertain to the subject?
14. Are knowledge and learning shown as an enterprise connected to society?

15. Are the objectives clearly stated?
16. Are instructions for teachers clear?
17. Can the materials be adapted to varied learning environments (large or small class, mixed level classes, etc.)?
18. Is the writing engaging?
19. Can these materials be readily integrated into an already established curriculum?
20. Do the materials follow a natural progression?
21. Are the materials organized in an easy-to-use fashion?
22. Are student materials sufficiently supplied?
23. Are there suggestions for further investigations?
24. Are there good visual illustrations?
25. Are the materials called for reasonably accessible?

V. ENERGY CONTENT

26. Are the laws of thermodynamics addressed?
27. Is the flow of energy through ecosystems included?
28. Are various energy sources (solar, wind, hydro, conservation, geothermal, nuclear, oil, coal, natural gas, O.T.E.C., biomass) treated?
29. Are renewable and nonrenewable energy sources compared and contrasted?
30. Do lessons include actual student participation in energy conservation?
31. Do the materials help students understand the roles of individuals, families, communities, and government, in forming energy policy?
32. Is consideration given to long-term benefits and costs?
33. Relative to other energy curriculum you've seen how would you rate this?
a) top 5 b) top 10 c) top 20 d) not in the top 20

VI. NARRATIVE RESPONSES

34. What stands out about these materials?
35. What are the greatest strengths?
36. What are the greatest weaknesses?
37. Please note any other reactions you may have to this curriculum material.

Energy Curricula Evaluated, But Not Included

The following materials were evaluated by the teacher teams, but not chosen for inclusion due to their lower ratings on the four point scale. These items may be useful tools for teaching about energy, but did not meet the curriculum guide lines in some way.

Key to ratings: ★★★★★ Excellent or "A" ★★ Poor or "D"

Rating Item

- ★★ *4th R Recycling Curriculum*, grades K-5, San Francisco Recycling Program, School Education Program, Rm. 271 City Hall, San Francisco, CA 94102, (415) 554-4851 or Pacific Gas and Electric. Narrow focus on San Francisco recycling, but reviewers felt it was a good model and very teacher friendly.
- ★★ *Electricity Choices*, grades 7-9, SMUD (Sacramento Municipal Utility District, Southern California Edison, or Los Angeles Department of Water and Power).
- ★★ *Energy in Science Series*, grades 9-12, National Energy Foundation, 5160 Wiley Post Way, Suite 200, Salt Lake City, UT 84116, (801) 539-1406.
- ★★ *Energy and Economics*, grades 9-12, National Energy Foundation, 5160 Wiley Post Way, Suite 200, Salt Lake City, UT 84116, (801) 539-1406.
- ★★ *Hawaii Energy Curriculum Guide*, grades K-12, Hawaii State Energy Office, DBED, Energy Division, 335 Merchant Street, Room 110, Honolulu, HI 96813, (808) 548-2334.
- ★★ *Classroom Energy Poster Puzzle*, grades K-4, Pacific Gas and Electric, Educational Services, 77 Beale Street Street, Room 2825, San Francisco, CA 9406-9900 or Alberta Energy, Energy Conservation Branch, Highfield Place, 2nd Floor, 10010 106 Street, Edmonton, Alberta, Canada, T5J3L8, (403) 427-5200, or California Energy Extension Service, 1400 Tenth Street, Room 209, Sacramento, CA 94814, (916) 323-4388.
- ★★ *Home Energy Poster Puzzle*, grades K-4, Pacific Gas and Electric, Educational Services, 77 Beale Street Street, Room 2825, San Francisco, CA 9406-9900 or Alberta Energy, Energy Conservation Branch, Highfield Place, 2nd Floor, 10010 106 Street, Edmonton,

Alberta, Canada, T5J3L8, (403) 427-5200.

- ★★ *Energy Conservation Education for New York State*, grades 7-12, New York State Education Department, Room 232-M, Albany, NY 1223, (518) 474-3852.
- ★★ *The Magic of Electricity*, grades 3-6, LHS GEMS Lawrence Hall of Science, University of California, Berkeley, CA 94720, (510) 642-1916.
- ★ *Energy Tech Knowledge*, grades K-6 (one publication for each grade), California Energy Extension Service, 1400 Tenth Street, Room 209, Sacramento, CA 95814, (916) 323-4388.
- ★ *Energy and Man's Environment*, grades 9-12, 4980 W. Amelia Earhart Drive, Salt Lake City, UT 84116, (801) 539-1406.
- ★ *The Energy Challenge*, grades 5-8, Technical Information Center, P.O. Box 62, Oak Ridge, TN 37830.
- ★ *Energy Reporter*, grades 9-12, Electric Power Research Institute, P.O. Box 10412, Palo Alto, CA 94303, (415) 855-2000.
- ★ *Science Activities in Energy*, grades 4-9, Pacific Gas and Electric, or Arizona Energy Office, 3800 N Central, Suite 1200, Phoenix, AZ 85012.

Energy Curricula Not Evaluated

The ten items listed below were not published in time for the original review of materials, but are worth mentioning. The first four items recently won awards from the U.S. Department of Energy or Environmental Protection Agency. Items four through eight were evaluated in the *Compendia for Integrated Waste Management (IWM)* or *Human Communities (HC)* and their respective scores are noted at the end of each entry.

1. *Universal House Activity Guide* and *California Native American Poster Series*, grades 3 - 8, 1992, 36 pages. Free. California Energy Extension Service, 1400 10th Street, Sacramento, CA 95814, (916) 323-4388.

Multi-cultural activities linking energy and passive solar design principles (insulation, shade, orientation, and thermal mass) with traditional California Indian housing. Full color posters (20 by 24 inches) are suitable for framing.

2. *Trash for the Long Haul*, grades K-12, January 1991, 153 pages, \$17.00. Missouri Energy Resources Project, 7838 Big Bend Road, Webster Groves, MO 63119.

Two-thirds of this book is dedicated to nine case studies that focus mostly on recycling issues. Very nicely presented.

3. *Elementary Energy and Environment Science Activities*, grades K-2, 3-4, and 5-6, June 1991 (originally published in 1984 by New York Energy Education Project), 100 pages each, Free, Pennsylvania Energy Office, 116 Pine Street, Harrisburg, PA 17101.

Five guides that integrate energy and environmental issues into general science curricula. Well organized. Each activity begins with a question. Fairly equal coverage of energy basics and personal choice.

4. *Think Earth*, grades K-3 and 4-6, \$50 per unit including video.

Educational Development Specialists, 5505 E. Carson Street, Suite 250, Lakewood, CA 90713, (310) 420-6814.

Materials were developed by the same firm that did *Energy Source* materials. 5 lesson units beautifully designed and presented with engaging graphics. Themes are articulated across grade levels, although more emphasis is on energy and waste management. Scored B+ in HC at K-6 grade and A- in IWM at 4-6 grade. Some Spanish materials.

5. *Impact! Environmental Activities with an International Focus*, grades K-6, 1990, \$19.95 with bulk discounts. Environmental Literacy Group, 33770 Woodland Drive, Evergreen, CO 80439, (303) 674-3853.

A valuable collection of 6 units, well presented and organized with good information and questions that promote critical thinking. Among the six units is one on renewable and non-renewable energy, and another on oil spills. Scored B+ in HC at K-3 grade.

6. *Earth Time*, grades 10-12, Revised 1994 as E2, 275 pages, \$125 for seven units. E2, 881 Alma Real Drive, Suite 118, Pacific Palisades, CA 90272, (310) 573-9608. Binder of activities to guide secondary students in an ecological audit of school--energy, water, pesticides, chemicals, foods, recycling, and gardens. Links social science, health and science. Scored B+ in HC and B- in IWM. Translation into several languages planned.

7. *Breakthroughs*, grade level specific for grades 1-8, 1992, 25 pages, \$19.95 teacher's edition, \$4.95 for student booklets. Bulk discounts.

Zaner-Bloser 2200 West Fifth Avenue, PO Box 16764, Columbus OH 43216-6764, (800) 421-3018.

Each in the series of 58 interdisciplinary booklets focuses on a real-world issues such as rain forests, diminishing energy supplies, acid rain, and global warming. Series is being considered for adoption as science textbook in California. Fifteen units address energy issues including motion, windmills, rainforests, electricity, smog, and greenhouse. Emphasis on thematic teaching, critical thinking, and collaborative learning designed to implement recommendations of Project 2061. Good graphic organizers such as network trees. Scored a B in HC for 4-6 grade.

8. *Energy, Economics & the Environment*, grades 7-9, 1993, 119 pages, \$5.00.

Indiana Dept. of Education, Rm. 229, State House, Indianapolis, IN 46204, (317) 232-9141.

Four case studies help students link the three issues, e.g. waste in school cafeteria. Scored B in HC.

9. *Science Projects in Renewable Energy and Energy Efficiency*, grades K-12, 1991, 140 pages, \$10.00 plus \$3.00 shipping. National Energy Foundation, 5160 Wiley Post Way, Suite 200, Salt Lake City, UT 84116, (801) 539-1406.

Developed by the former Solar Energy Research Institute, the guide introduces the technologies and follows with ideas for experimental projects demonstrating the scientific method. Ideal for science fair projects. Topics include solar, photovoltaics, geothermal, biofuels, wind, superconductivity, hydrogen, and energy efficiency. One third of the book lists of resources.

10. *Mouse House Surprise*, grades K-1, 1993, 32 pages, \$6.00, Enterprise for Education, 1316 3rd St. Suite 103, Santa Monica, CA 90401, (310) 394-9864.

Big book/little book format with large letters to help children learn to read. Story of mouse family's use of electricity as well as safety.